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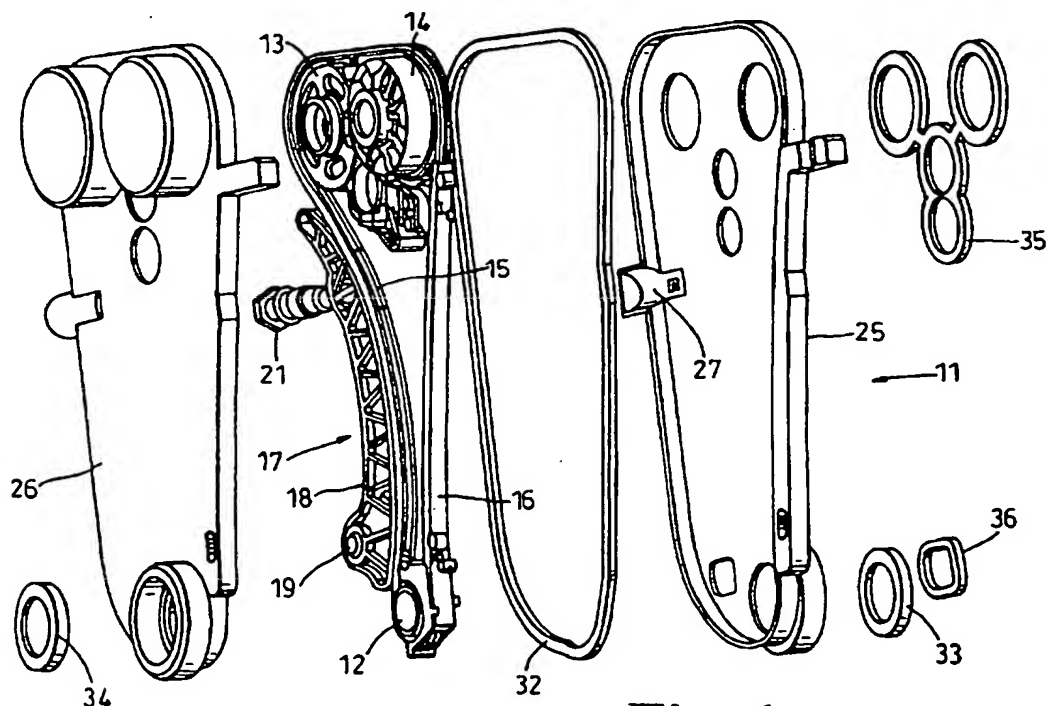
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(56) Documents Cited  
GB 2247282 A GB 2230560 A GB 0595249 A  
US 4869708 A

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INT CL<sup>6</sup> F01L 1/02 1/047 1/053, F02F 7/00, F16H 7/18  
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(54) Abstract Title  
**Pre-assembled flexible drive assembly, eg for I.c. engine camshafts**

(57) A flexible drive assembly 11 includes a crankshaft sprocket 12 and camshaft sprockets 13, 14 connected by a timing chain 15. The chain 15 is provided with a guide rail 16 and a tensioner slipper 18. The chain and sprockets are mounted within cover parts 25, 26 which have recesses 27 to hold the tensioner housing 23 captive. The assembly of the chain, sprockets tensioner device and cover parts is assembled as a unit before assembly onto an engine.



**Fig. 1**

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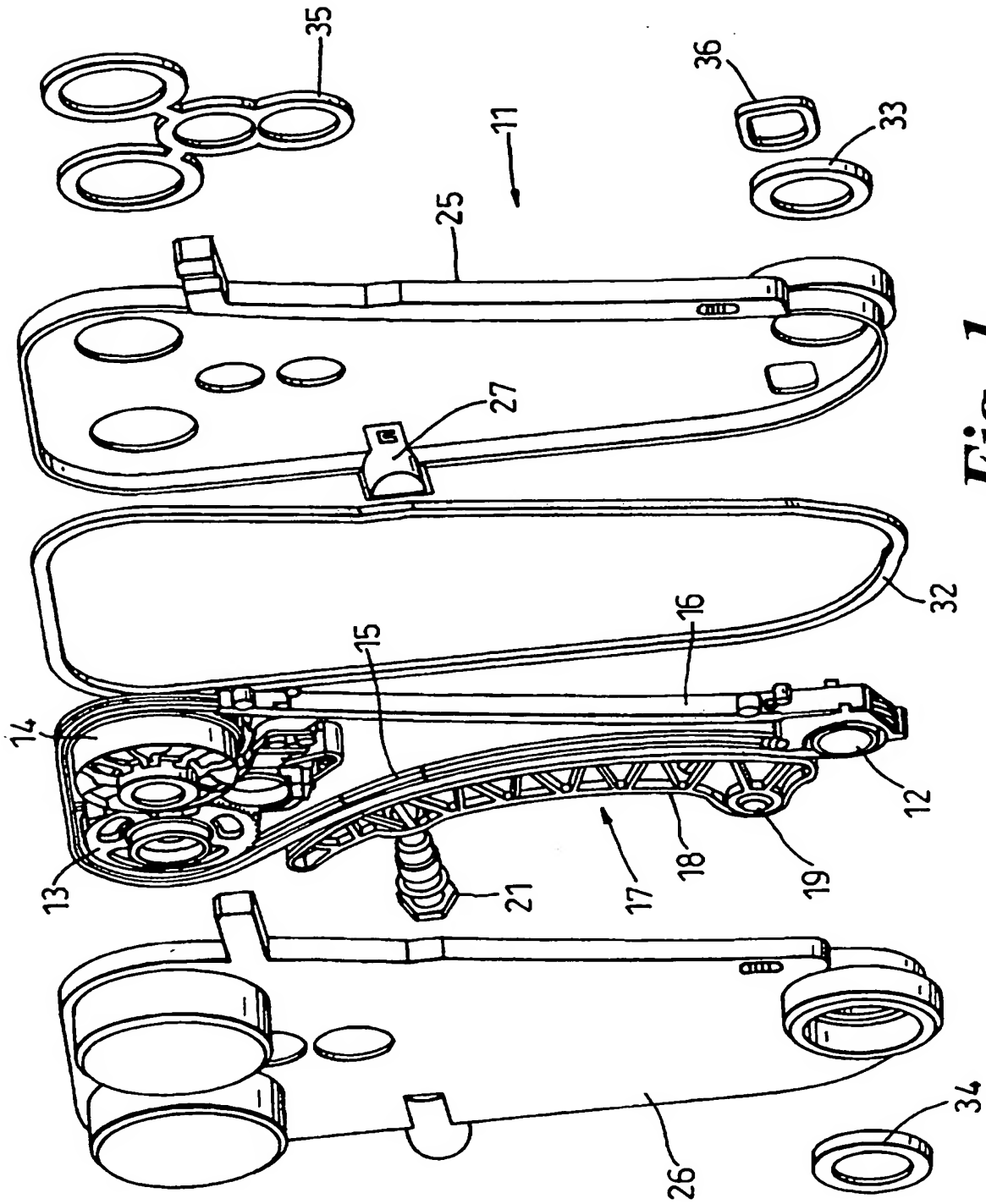


Fig. 1

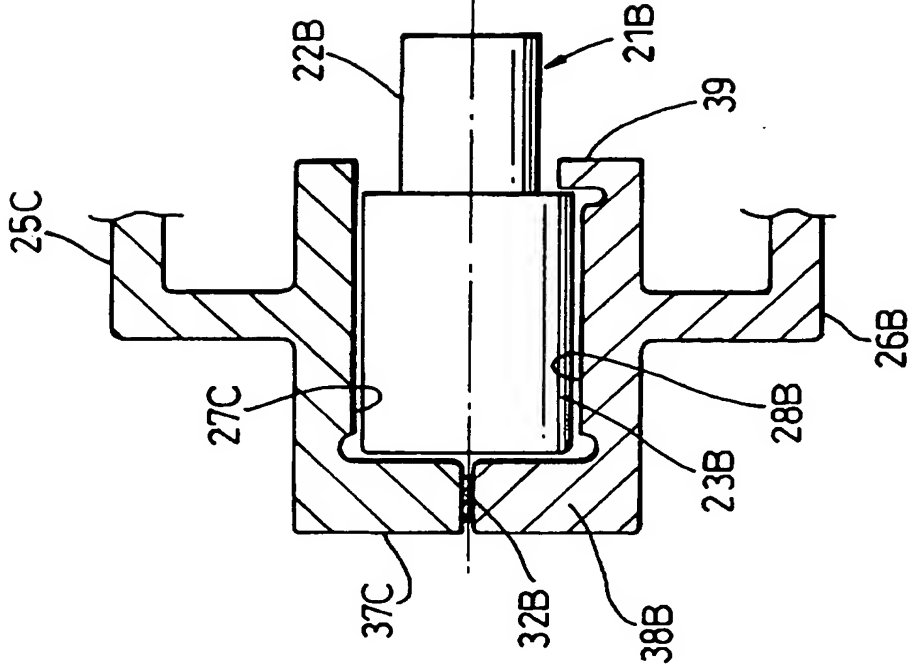


Fig. 3

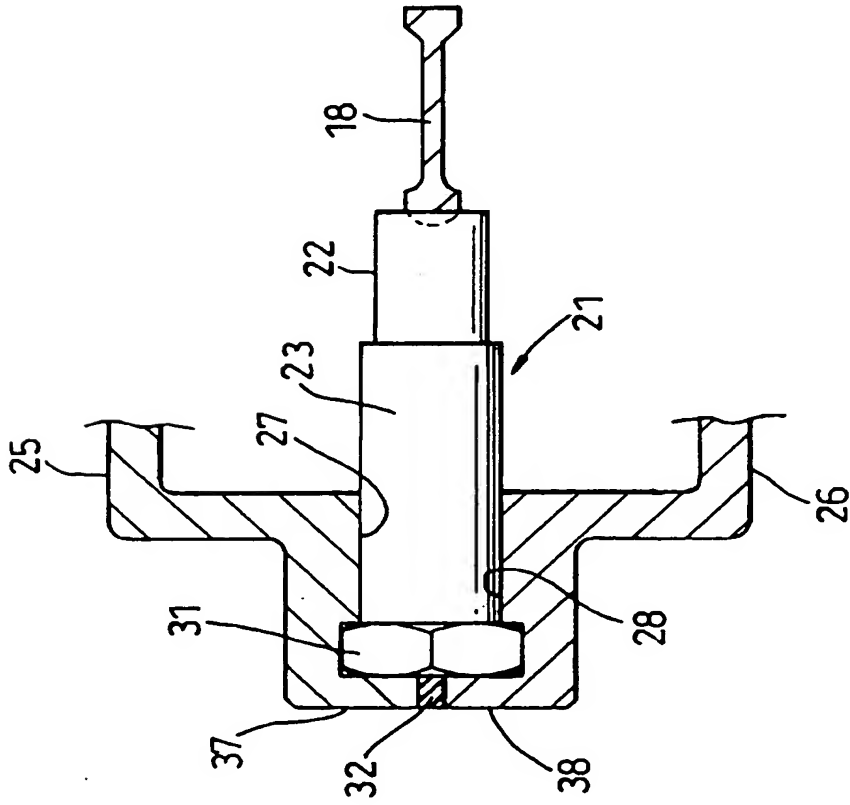
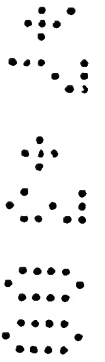


Fig. 2



A Flexible Drive Assembly

The invention relates to flexible drive assemblies for internal combustion engines, particularly but not exclusively for transmitting drive from an engine crankshaft to one or more camshafts.

EP-A-0 124 433 shows a flexible drive assembly for an internal combustion engine in which a driving sprocket on a crankshaft drives a driven sprocket on a camshaft through a flexible chain and a cover for the chain and the sprockets includes first and second cover parts. A tensioner device in the form of a flexible slipper has one end of the slipper carried on an eccentric shaft which can be rotated to slacken the tensioner for assembly purposes. Modern engines require a more sophisticated tensioner device which normally requires fixing either by its own screw threaded portion or by separate threaded fasteners. This adds time and expense to the assembly process and it is therefore an object of the present invention to provide a flexible drive assembly of the kind substantially as shown in EP-A-0 124 433 with an improved tensioner arrangement.

According to one aspect of the invention there is provided a flexible drive assembly for an internal combustion engine and comprising a driving sprocket, a driven sprocket and a flexible chain or belt arranged to transmit drive from the driving sprocket to the driven sprocket, a cover for the chain or belt and the sprockets, the cover including a first cover part and a second cover part, and a tensioner device for the chain or belt and including a tensioner housing which is held captive by the cover parts and a tensioner plunger which is slidable in the tensioner housing and acts on the chain or belt through a slipper.

The invention also provides a novel method of assembling a flexible drive assembly for an internal combustion engine. Hence, according to a second aspect of the invention there is provided a method of assembling a flexible drive assembly

for an internal combustion engine, the drive assembly comprising a driving sprocket, a driven sprocket and a flexible chain or belt arranged to transmit drive from the driving sprocket to the driven sprocket, a cover for the chain or belt and the sprockets, the cover including a first cover part and a second cover part, and a  
5 tensioner device for the chain or belt and including a tensioner housing which is held captive by the cover parts and a tensioner plunger which is slidable in the tensioner housing and acts on the chain or belt through a slipper, the method including the steps of assembling the chain or belt onto the sprockets, assembling the chain or belt, with the sprockets, into one of the cover parts, supplying the  
10 tensioner device and inserting the tensioner housing into said one cover part and assembling the other of the cover parts onto said one cover part.

Preferably, and in accordance with both aspects of the invention, the tensioner housing is located between the cover parts, in which case the tensioner housing may be located in a recess in each of the cover parts. The tensioner  
15 housing may be substantially cylindrical and the recess in each of the cover parts may be semi-circular.

Conveniently, the tensioner housing may have a hexagonal portion which is located in a complementary recess in one or both of the cover parts. Alternatively or additionally, the recess in the or each cover part has an end wall for abutment  
20 with the tensioner housing. The recess may have a lip for abutment with the tensioner housing to prevent movement of the tensioner housing towards the chain or belt. Alternatively, the tensioner housing may have a flange or circlip which is located in a groove in one or both of the cover parts or a rib or a projection on one or both of the cover parts may be engaged in a groove or recess in the tensioner  
25 housing.

The driving sprocket may be arranged to be driven by a crankshaft of the engine and the driven sprocket is arranged to drive a camshaft of the engine, in which case the first cover part may be arranged between the chain or belt and a cylinder block of the engine and the second cover part may be joined to it along a joint face which is substantially perpendicular to the crankshaft axis. Preferably,  
5 the sprockets, the chain or belt and the tensioner are assembled within the cover parts before assembly onto the engine.

The invention will now be described by way of example and with reference to the accompanying drawings, of which:-

10 Fig.1 is an exploded perspective view of the components of a flexible drive assembly according to the invention;

Fig.2 is a partial cross-section showing a tensioner device and cover part of the assembly shown in Fig.1; and.

Fig.3 is a partial cross-section similar to Fig.2 showing modifications.

15 Referring to Figs.1 and 2, a flexible drive assembly 11 for an internal combustion engine includes a driving sprocket 12 for mounting on the crankshaft of the engine and two driven sprockets 13, 14 for attachment to a respective one of two overhead camshafts of the engine. A flexible roller chain 15 (conventionally known as a "timing chain") passes round the outside of the sprockets so that in use  
20 the camshafts are driven by the crankshaft in the normal manner.

The sprockets 12, 13, 14 rotate clockwise as seen from the left of Fig.1 so that the run of chain between the driving sprocket 12 and driven sprocket 14, which in this particular case is for the inlet camshaft, is normally under tension. However, to prevent unwanted vibrations in this part of the chain 15, a guide or snubber rail  
25 16 is provided to impart a small inward curvature to the chain. Conversely, the run of chain between the other driven sprocket 13, in this case for the exhaust

camshaft, and the driving sprocket 12 is not normally under tension and this is provided with a tensioner device 17 which includes an arcuate tensioner rail or slipper 18 which is pivoted at 19 and biased towards the chain 15 by a tensioner device or actuator 21. The tensioner device 21 is of a known kind which a plunger 5 22 is slidable in a substantially cylindrical tensioner housing 23. The tensioner device 21 incorporates a light spring to bias the tensioner plunger 22 towards the chain 15 and a ratchet to prevent tensioner plunger from moving in the opposite direction.

The sprockets 12, 13, 14, chain 15, snubber rail 16 and tensioner device 17 are 10 housed in a cover which comprises a first cover part 25 arranged between the timing chain 15 a cylinder block of the engine and a second cover part 26 which is joined to the first cover part along a joint face which is substantially perpendicular to the crankshaft axis and sealed by a gasket 32. The tensioner housing 23 is held captive by the cover parts 25, 26, the tensioner housing being located in 15 complementary semi-circular recesses 27, 28 in the respective cover parts 25, 26. The tensioner housing 23 has a hexagonal head 31 which locates in complementary parts of the recesses 27, 28 to locate the tensioner device 21 axially, the hexagonal head 31 abutting an end wall 37 of the recess 27 and an end wall 38 of the recess 28.

20 The flexible drive assembly 11 is assembled by first assembling the chain 15 onto the sprockets 12, 13, 14, and assembling these into one of the cover parts, typically the first cover part 25. The snubber rail 16 and the tensioner slipper 18 are mounted at the same time. The tensioner device 21 is then inserted into its recess 27 in the cover part 25 and the other cover part 26 with the gasket 32 25 assembled to provide a complete assembly which can then be mounted onto the engine. The cover parts 25, 26 are provided with lip seals 33, 34 for the crankshaft and gaskets 35 and 36 are provided to seal between the first cover part 25 and the

engine block and cylinder head where apertures are provided for the camshafts and other purposes.

The tensioner device 21 may include a piston which is part of or drives the plunger 22 to supplement or replace the internal spring. Pressure from an engine  
5 oil pump can be provided through appropriate passages in the first cover part 25 which would then be provided with an appropriate connection to the cylinder block or head.

Fig.3 shows a modified tensioner device 21B in which the tensioner housing 23B has a plain cylindrical outer surface which is located in plain semi-circular  
10 recesses 27C and 27B. The recesses 27C and 28B are shown as alternatives in Fig.3, one alternative being shown above the axis of the tensioner plunger 22B and the other alternative being shown below the axis, the difference being that recess 28B has a lip 41 to prevent movement of the tensioner device towards the chain 15 during assembly of the parts. When the parts are assembled, the lip is  
15 unnecessary because the tensioner plunger 22B biases the tensioner housing 23B towards the recess end walls 37C and 38B.

Alternative location for the tensioner housing 23 can be provided by a flange or circlip locating in a groove in the cover parts 25, 26 or by a rib or projection on one or both of the cover parts engaging in a groove or recess in the tensioner  
20 housing.

The sprockets 12, 13, 14, chain 15, snubber rail 16 and tensioner slipper 18 may be directly mounted in one of the cover parts 25, 26 or may be pre-assembled in a manner similar to that shown in EP-A-0 823 543 before fitting between the cover parts.



CLAIMS

1. A flexible drive assembly for an internal combustion engine and comprising a driving sprocket, a driven sprocket and a flexible chain or belt arranged to transmit drive from the driving sprocket to the driven sprocket, a cover for the chain or belt and the sprockets, the cover including a first cover part and a second cover part, and a tensioner device for the chain or belt and including a tensioner housing which is held captive by the cover parts and a tensioner plunger which is slidable in the tensioner housing and acts on the chain or belt through a slipper.
2. An assembly according to claim 1 wherein the tensioner housing is located between the cover parts.
3. An assembly according to claim 2 wherein the tensioner housing is located in a recess in each of the cover parts.
4. An assembly according to claim 3 wherein the tensioner housing is substantially cylindrical and is located in a semi-circular recess in each of the cover parts.
5. An assembly according to claim 3 or claim 4 wherein the tensioner housing has a hexagonal portion which is located in a complementary recess in one or both of the cover parts.
6. An assembly according to any of claims 3 to 5 wherein the recess in the or each cover part has an end wall for abutment with the tensioner housing.
7. An assembly according to any of claims 3 to 6 wherein the recess has a lip for abutment with the tensioner housing to prevent movement of the tensioner housing towards the chain or belt.

8. An assembly according to any of claims 3 to 5 wherein the tensioner housing has a flange or circlip which is located in a groove in one or both of the cover parts.
9. An assembly according to any of claims 3 to 5 wherein a rib or projection on one or both of the cover parts is engaged in a groove or recess in the tensioner housing.
10. An assembly according to any preceding claim wherein the driving sprocket is arranged to be driven by a crankshaft of the engine and the driven sprocket is arranged to drive a camshaft of the engine.
11. An assembly according to claim 10 wherein the first cover part is arranged between the chain or belt and a cylinder block of the engine and the second cover part is joined to it along a joint face which is substantially perpendicular to the crankshaft axis.
12. An assembly according to claim 10 or claim 11 wherein the sprockets, the chain or belt and the tensioner are assembled within the cover parts before assembly onto the engine.
13. A method of assembling a flexible drive assembly for an internal combustion engine, the drive assembly comprising a driving sprocket, a driven sprocket and a flexible chain or belt arranged to transmit drive from the driving sprocket to the driven sprocket, a cover for the chain or belt and the sprockets, the cover including a first cover part and a second cover part, and a tensioner device for the chain or belt and including a tensioner housing which is held captive by the cover parts and a tensioner plunger which is slidable in the tensioner housing and acts on the chain or belt through a slipper, the

method including the steps of assembling the chain or belt onto the sprockets, assembling the chain or belt, with the sprockets, into one of the cover parts, supplying the tensioner device and inserting the tensioner housing into said one cover part and assembling the other of the cover parts onto said one cover part.

14. A method according to claim 13 wherein the tensioner housing is located between the cover parts.
15. A method according to claim 14 wherein the tensioner housing is located in a recess in each of the cover parts.
16. A method according to claim 15 wherein the tensioner housing is substantially cylindrical and is located in a semi-circular recess in each of the cover parts.
17. A method according to claim 15 or claim 16 wherein the tensioner housing has a hexagonal portion which is located in a complementary recess in one or both of the cover parts.
18. A method according to any of claims 15 to 17 wherein the recess in the or each cover part has an end wall for abutment with the tensioner housing.
19. A method according to any of claims 15 to 18 wherein the recess has a lip for abutment with the tensioner housing to prevent movement of the tensioner housing towards the chain or belt.
20. A method according to any of claims 14 to 17 wherein the tensioner housing has a flange or circlip which is located in a groove in one or both of the cover parts.

21. A method according to any of claims 14 to 17 wherein a rib or projection on one or both of the cover parts is engaged in a groove or recess in the tensioner housing.
22. A method according to any of claims 13 to 21 where the driving sprocket is arranged to be driven by a crankshaft of the engine and the driven sprocket is arranged to drive a camshaft of the engine.
23. A method according to claim 22 wherein the first cover part is arranged between the chain or belt and a cylinder block of the engine and the second cover part is joined to it along a joint face which is substantially perpendicular to the crankshaft axis.
24. A method according to claim 22 or claim 23 wherein the sprockets, the chain or belt and the tensioner are assembled within the cover parts before assembly onto the engine.
25. A flexible drive assembly substantially as described herein with reference to the accompanying drawings.
26. A method of assembling a flexible drive assembly for an internal combustion engine substantially as described herein with reference to the accompanying drawings.



Application No: GB 9903954.7  
Claims searched: 1 to 26

Examiner: John Twin  
Date of search: 20 April 1999

**Patents Act 1977**  
**Search Report under Section 17**

**Databases searched:**

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:  
UK Cl (Ed.Q): F1B (B2P16, B6A); F2Q  
Int Cl (Ed.6): F01L 1/02, 1/047, 1/053; F02F 7/00; F16H 7/18, 57/02  
Other: Online: EPODOC, JAPIO, WPI

**Documents considered to be relevant:**

Category	Identity of document and relevant passage	Relevant to claims
A	GB 2247282 A (Mercedes-Benz) - see eg figure 1	
A	GB 2230560 A (Nissan) - see eg figure 1	
A	GB 595240 (Morse Chain) - see eg p.3, lines 60-80	
A	US 4869708 (Borg Warner) - see eg col.1, lines 21-52	

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.